

Cogeneration Facility HYSYS Simulation

Process Measurements Fall 1998

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In this exercise you will simulate the two heat exchangers in the cogeneration unit using a chemical process simulation package from Hyprotech Inc. This program is used by industry to design and simulate process plants such as oil and gas refineries, chemical and pharmaceuticals production facilities. A typical sampling of well-known companies using this software are given below:

- DuPont, Eastman Kodak, Monsanto, Hoechst Celanese, Rohm & Haas
- Shell, Amoco, Exxon Chemical, Olin, Conoco, Phillips
- Foster Wheeler, Arthur D. Little, Ballard, Koch
- Hoffman LaRoche, International Flavors and Fragrances,

This software is written in C++ which is a language that you will learn next semester. The cost of this software is approximately \$45,000 for the dynamic version and \$20,000 for the steady-state version. This price is for only one user! For more information on Hyprotech go to www.hyprotech.com

You have just returned from the Rowan Cogeneration Plant tour with a table of readings for the water flow in the process given below. Using your measurements of temperature, pressure and flowrate we will simulate two heat exchangers. The overall process for this simulation is to

- Select a thermodynamics package that describes the physical and chemical properties of water
- Select two heaters
- Define all required inputs and output streams. Specify required values of temperature, pressure, flowrate and chemical concentration.

Start your computer:

Start the computer by pressing ctrl alt del simultaneously.

Log in following procedure given to you in class.

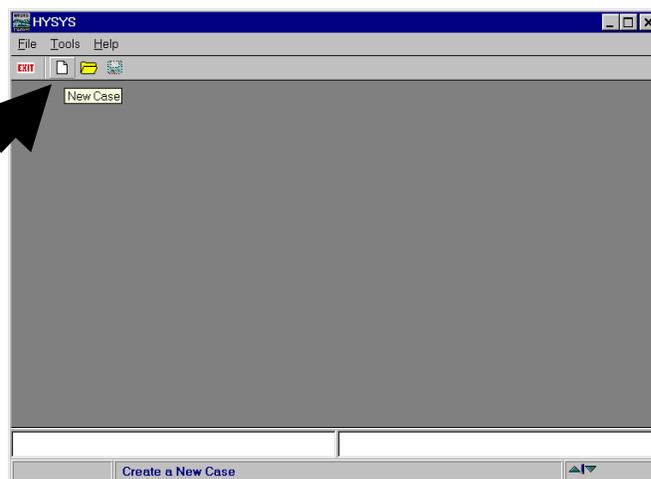
Make sure your server is IROWANENG for the domain

Go to Start; Engineering Apps; and choose HYSYS

This package will take about a minute to start up and when complete you will see the screen given above.

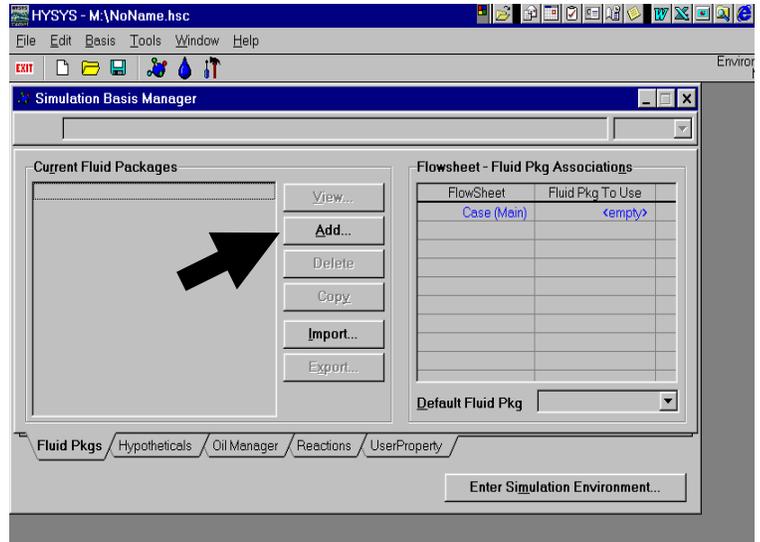
To start a new case click on the white page icon or use the commands File New Case.

Please note that the manuals can be viewed by mapping the drive [\\ENGNET1\OPENAREA](#) and going to "Openarea on 'Engnet1'" \Hsys Help/Menu.pdf

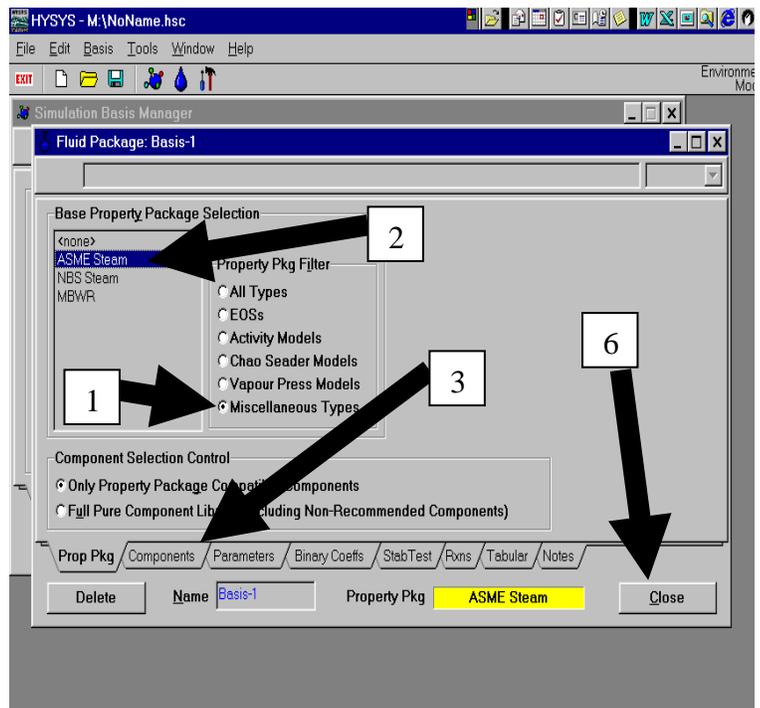


The result will be the following menu screen to choose a thermodynamic property package. You will learn more about these packages in your thermodynamics and chemical engineering thermodynamics courses. We will use the American Society of Mechanical Engineers (ASME) steam tables for our property package.

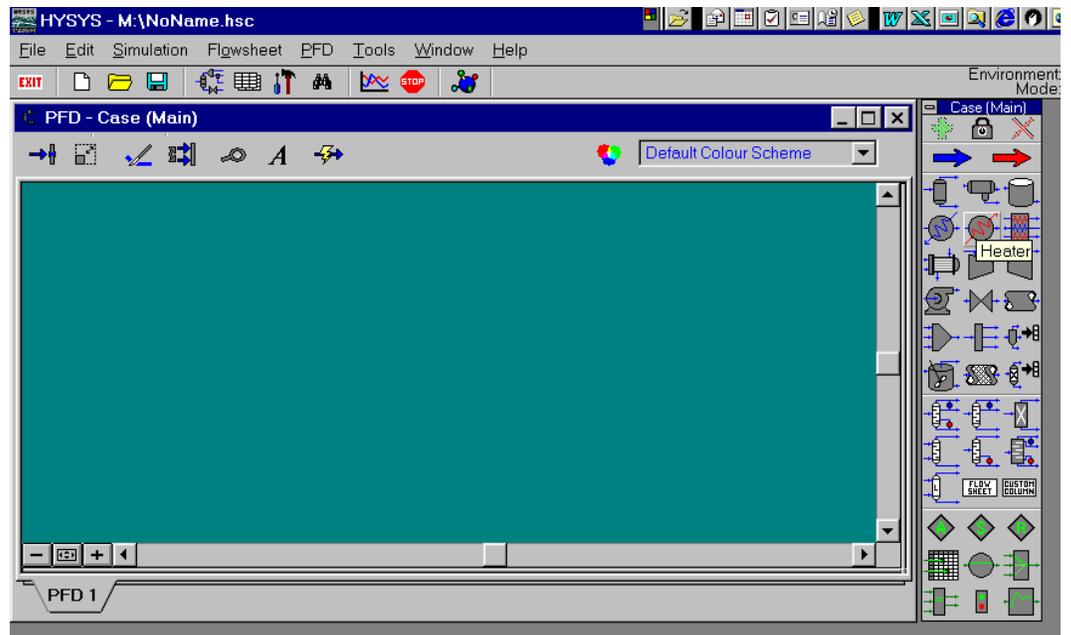
Choose the button Add...



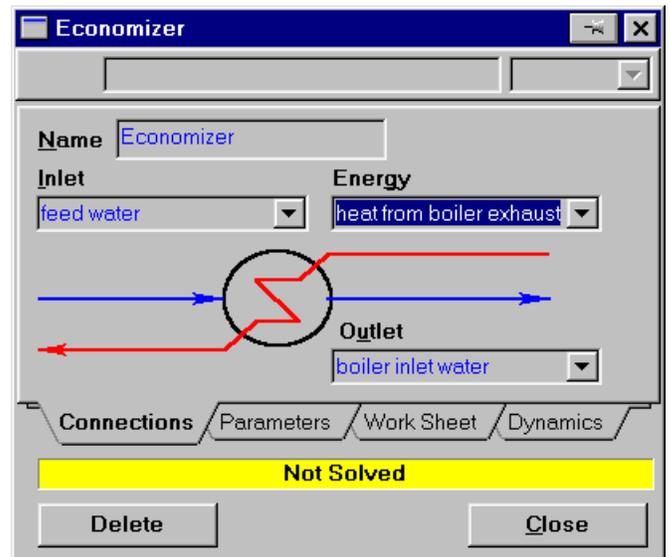
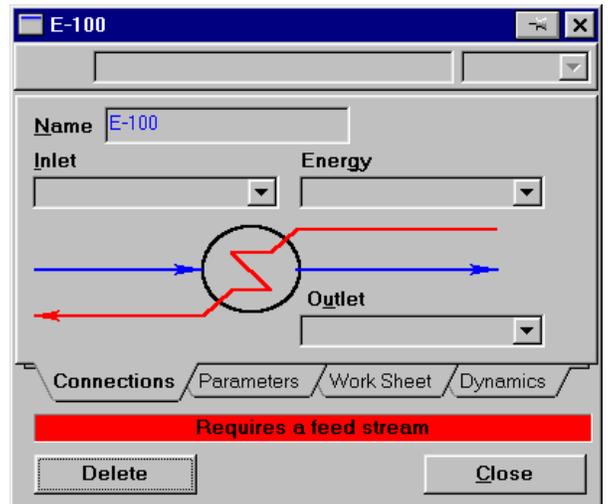
1. Choose Miscellaneous Types
2. Choose ASME Steam
3. Press the Components tab
4. Add Pure H₂O by selecting H₂O and pressing the Add Pure button
5. Press the Close button for this screen
6. Press the Enter Simulation Environment... Button (see figure above)



You should now see the following screen. In the green screen you will construct a process flow diagram (PFD) of the two cogeneration plant heaters. The pictures of equipment shown to the right of the green screen contains the equipment that you will add. We will add two heaters which are symbolized by a grey circle with a red jagged arrow passing through them.



- 1) Select the heater by first clicking on it and then release. Move the mouse to the green PFD screen and click a second time. Note this is not the traditional drag and drop!
- 2) Double click on the heater icon and the following menu will result. Notice that a red warning sign appears telling you what is required: "Requires a feed stream." The red stream is the hot exhaust gases and the blue stream is the water
- 3) Fill out this menu as follows:
 - a) Name: Economizer
 - b) Inlet: feed water
 - c) Energy: heat from boiler exhaust
 - d) Outlet: boiler inlet water
- 4) Choose Work Sheet tab



- f) Click on the Close button to close the Feed Water screen.
- 9) Enter the temperature and pressure for the boiler inlet water stream.
 - a) Double click on the stream name “boiler inlet water”
 - b) Enter the boiler inlet water temperature. I will use 345°F.
 - c) Enter the same pressure as the feed water pressure of 255 psig. Remember the final value will be 269.696 psia!

You will notice after you enter these two values of temperature and pressure, the remaining values of these streams will be calculated by HYSYS. The values in blue are the ones that you have entered and the values in black have been calculated by HYSYS. The value of the heat duty on the economizer, $Q_{economizer}$, is given as the Heat Flow of the energy stream “heat from boiler exhaust.” Using the values I have entered for this handout the heat duty (heat flow) is 1.53×10^6 Btu/hr. Or switching the units to SI (Tools, preferences, Units, SI) the heat duty is 1.62×10^6 kJ/hr. **The value of heat duty you have obtained using your readings should be nearly identical to the value you calculate in your homework problem.**

- d) Close the Economizer screen by clicking the Close button.

Boiler Heater Unit

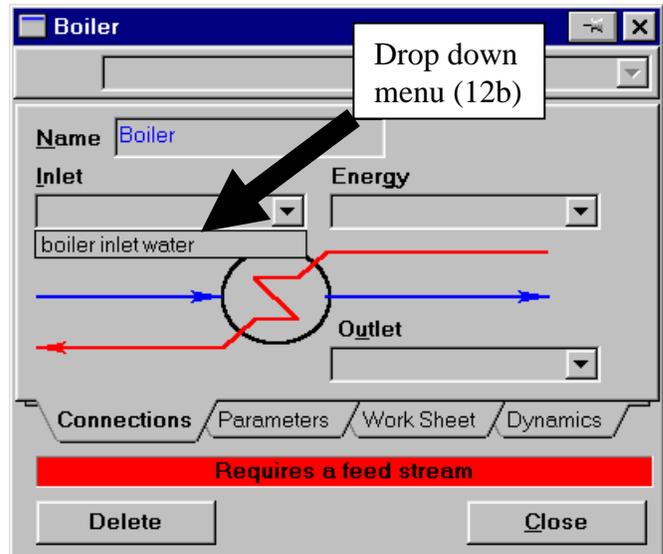
Now insert the heater unit that simulates the boiler.

- 10) Select the heater by first clicking on it and then release. Move the mouse to the green PFD screen and click a second time. Note this is not the traditional drag and drop!
- 11) Double click on the heater icon and the following menu will result. Notice that a red warning sign appears telling you what is required: Requires a feed stream. The red stream is the hot exhaust gases and the blue stream is the water.
- 12) Fill out this menu as follows:

- a) Name: Boiler
- b) For the inlet water stream to the Boiler unit you do not have to type the stream name in. Use the pull down menu to see the available streams. In this case there is only one stream available: “boiler inlet water.” Select this stream by clicking on it.
- c) Energy: heat from turbine exhaust
- d) Outlet: Steam

- 13) Choose the Work Sheet tab and enter your readings from the plant similar to that shown at right.

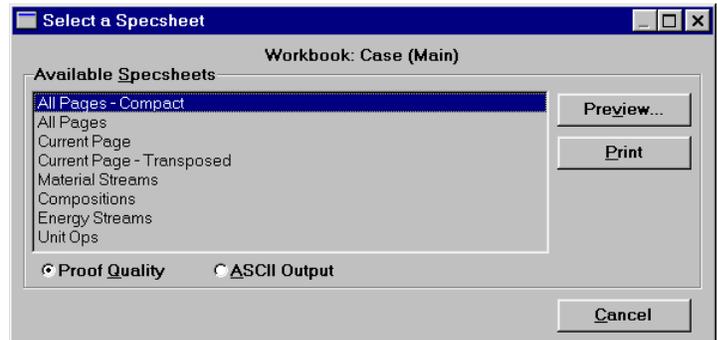
- 14) Notice that the boiler feed stream is already specified from the output of the economizer.



Name	boiler inlet wt	heat from turk	steam
Vapour	0.0000	<empty>	1.0000
Temperature [F]	345.0000	<empty>	365.8677
Pressure [psia]	269.6960	<empty>	164.6960
Molar Flow [lbmole/hr]	638.3534	<empty>	638.3534
Mass Flow [lb/hr]	11500.0000	<empty>	11500.0000
LiqVol Flow [barrel/day]	789.0266	<empty>	789.0266
Heat Flow [Btu/hr]	-7.5096e+07	1.0109e+07	-6.4986e+07

15) Specify the required variables for the Steam stream

- The steam from the boiler is *saturated* steam. You will learn more about saturated steam in your thermodynamics courses. To specify saturated steam in this simulation you will set the Vapour (that's English or Canadian) to a value of exactly 1.
- Enter the steam pressure. I will use 150 psig. Notice that the software automatically converts the pressure to absolute pressure by adding 14.696 psi to the value to get 164.696 psia. Also notice that all other stream values are calculated and the heat duty is determined. **Notice that the temperature of the steam, T_s , shown on your simulation (that you obtained using your steam pressure reading) should be identical to the value you will calculate in the homework.**
- The heat duty (heat flow) for the boiler obtained from the simulation may be higher than the value that you calculate in your homework. The value in your homework uses the mass flowrate of steam which may be different from the mass flowrate of the feed water stream.
- Add two summary tables to your PFD, by right clicking your mouse on a heater, and selecting Show Table.
- Close the Boiler screen by clicking on the Close button.



Printout two HYSYS workbook Specsheets.

One should be in SI and the other in field

units so that you can use these results to guide you in your homework solution.

To print a specsheat:

- Select the workbook by pressing the toolbar button as shown in the figure below.
- Select File, Print,
- Choose All Pages - Compact.
- Preview it

Also printout your process flow diagram, (PFD) by choosing the print command while the PFD is active.

Homework must be submitted one week from today at 8:00 a.m.

